Logical data integration into digital landscape model 2

Jaromír Kolejka – Mendel University of Agriculture and Forestry in Brno

Lecture contents:

- **brief description of present situation in geospatial data**
- **requirements for integtrated geodata**
- **methods of geodata integration**
- **introduction of digital landscape model**
- **construction methods of digital landscape model**
- **digital landscape model application ideas**

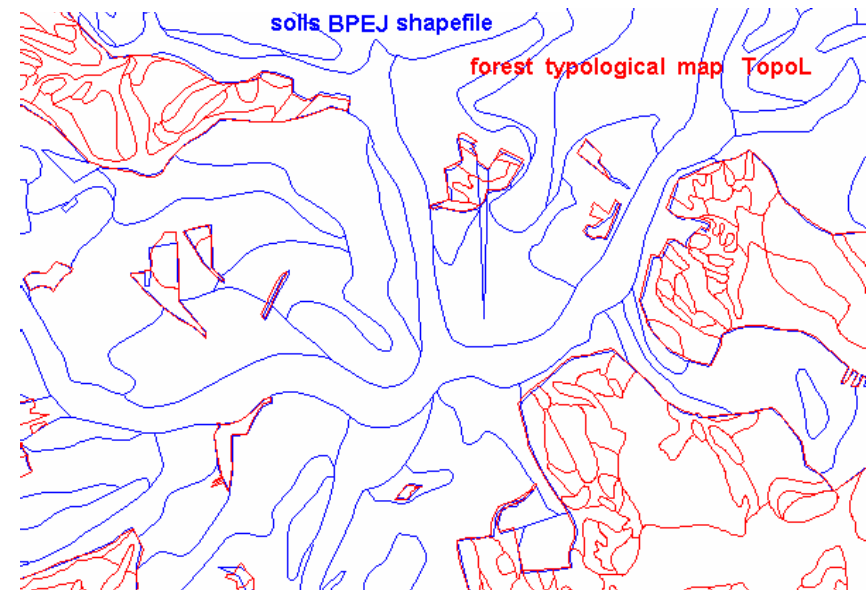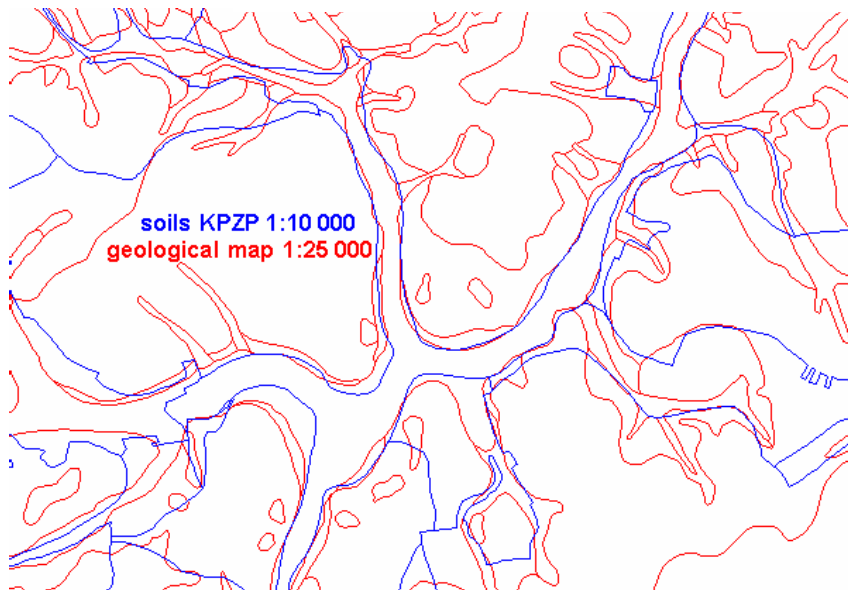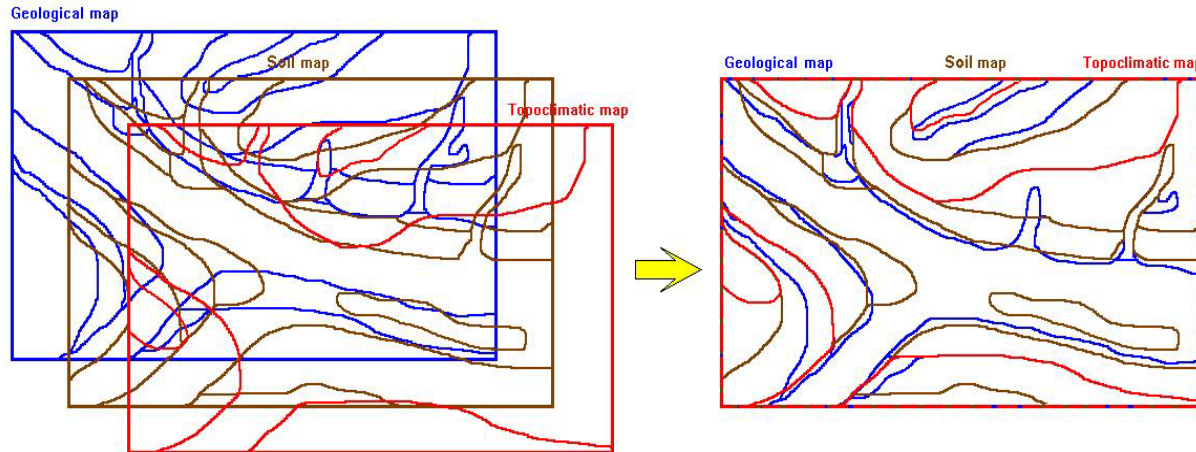Jaromír Kolejka – Mendel University of Agriculture and Forestry in Brno

Present situation in area of disposable geospatial data

- **Distributed databases are managed separately with complex access.**
- **Different data formats, scales, projection etc. used for stored data.**
- **Extended analogue data sets archived and not used appropriately.**

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Present situation in area of disposable

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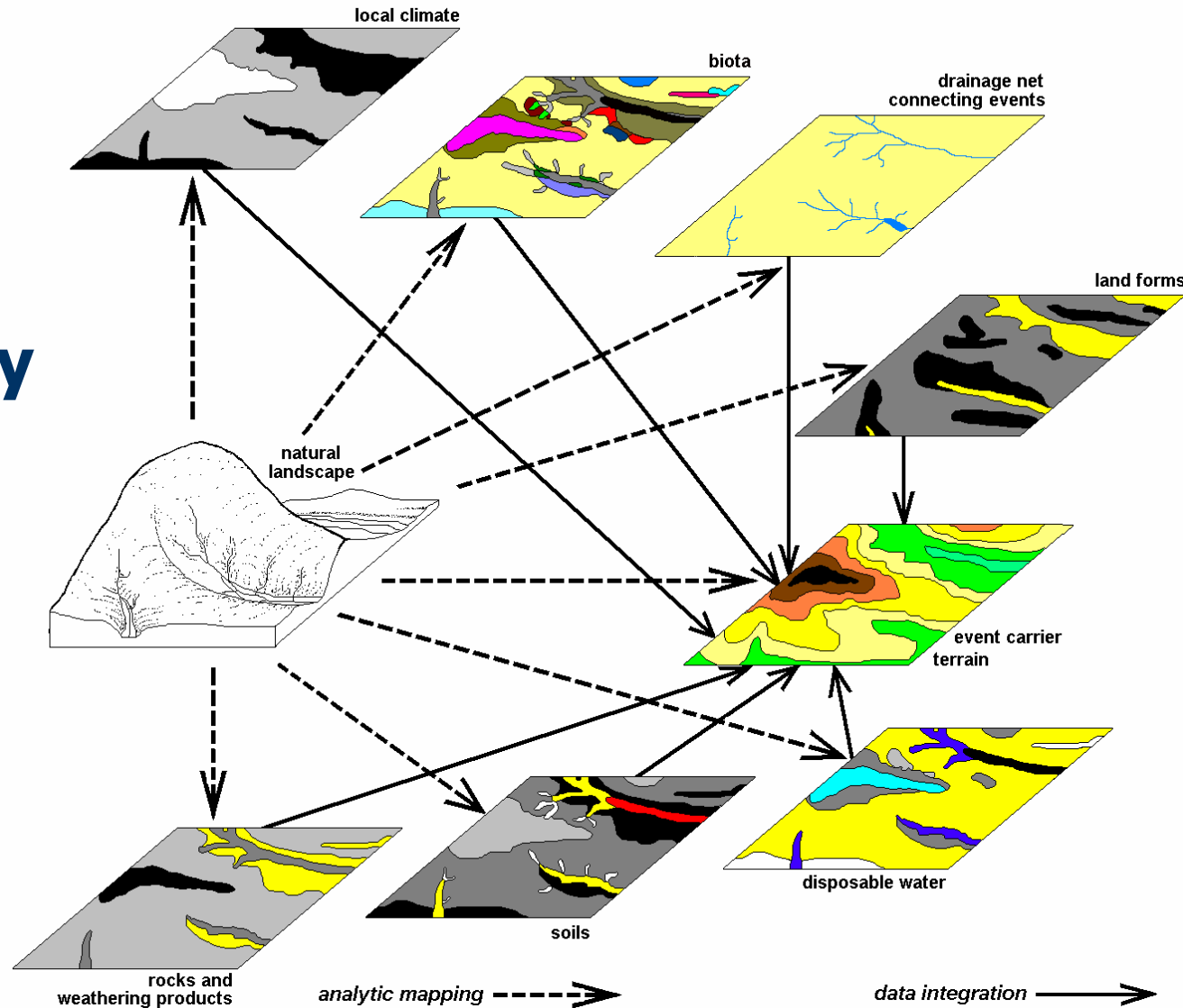
Present demand for data. Why is geospatial data useful?

■ **To carry out spatial analyses using traditional and non-conventional methods.**

■ **To apply external expert models to model various spatial processes.**

■ **To develop own expert models and procedures for geospatial data processing.**

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To remember: the most geodata originated by analytic approach

Geodata application recquires synthetic approach

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Present demand for geospatial data

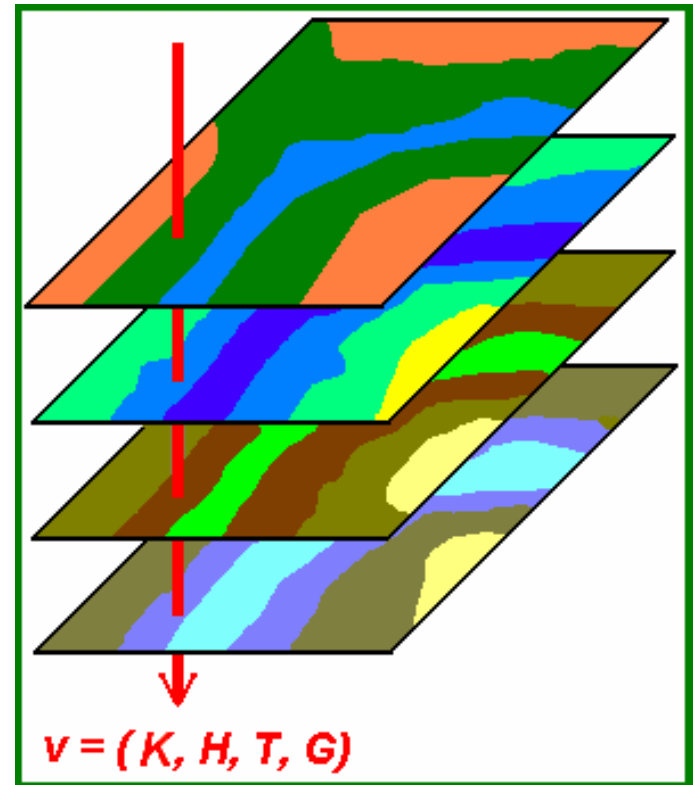**Idealistic view:**

Using data overlay, e.g. data on the nature, logical and real combination of attributes is created as required data input into processing/modelling procedure.

$$v = (K, H, T, G)$$

The real situation is very different – a suitable solution is proposed by the DIGITAL LANDSCAPE MODEL - DLM .

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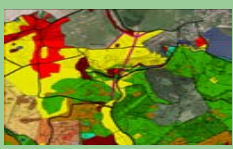
Integrated geodata base compilation
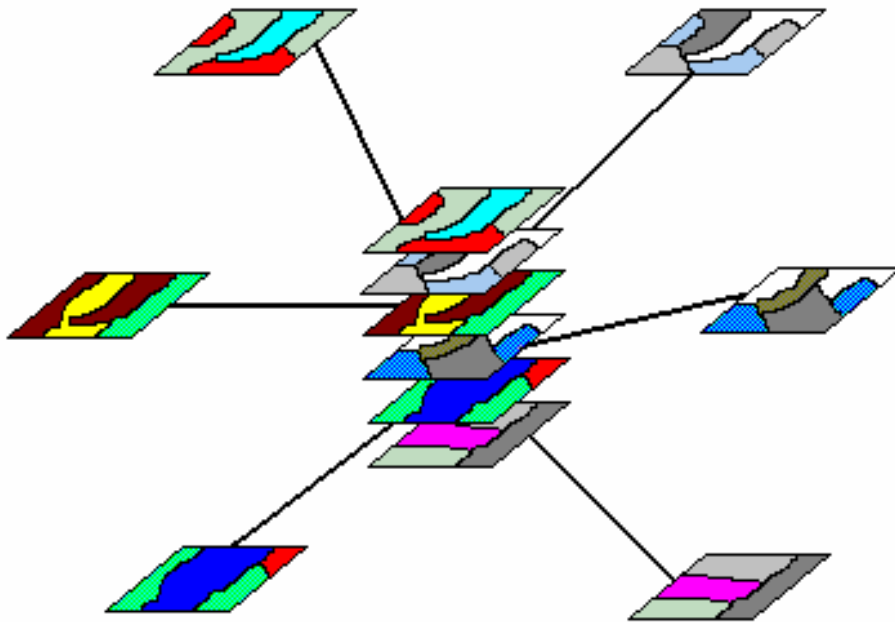
Traditional data base compilation task: collect data and put together
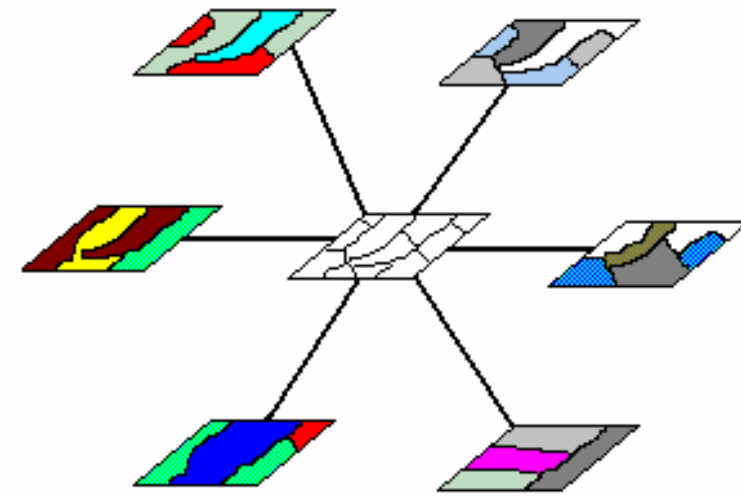
Geographic data base compilation task: collect and integrate data

Integrated geospatial data base + GIS and/or expert package = DLM

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What is the digital landscape model?
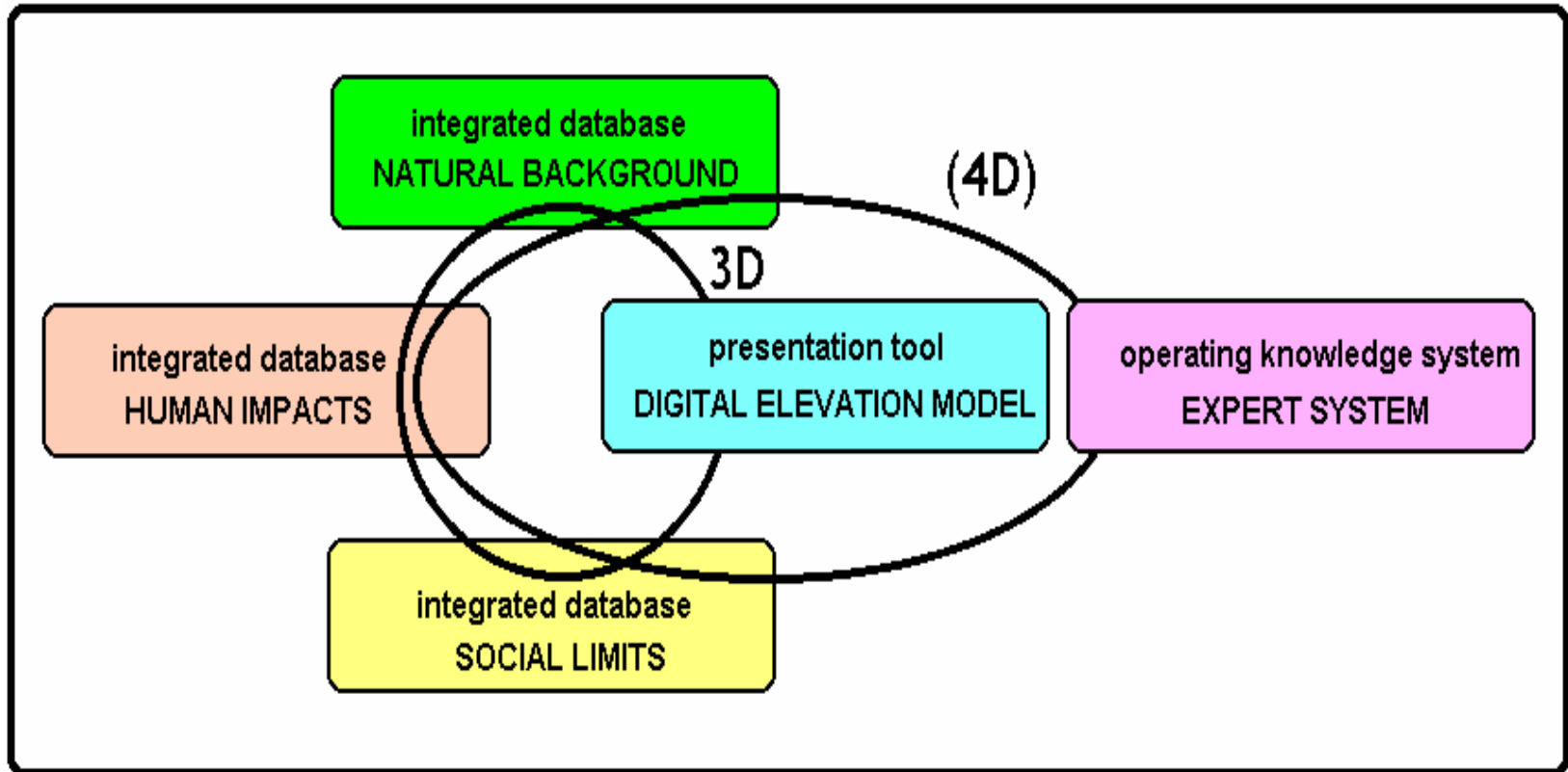
Demand on integrated geodata can be covered by the digital landscape model as an example of fully logically ballanced geodata base – as it is in real landscape.

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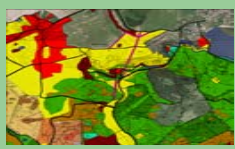
Digital landscape model definition

Digital landscape model is at least 3D-4D computer generated scheme of a segment of the Earth´s landscape sphere providing in a simplified, but integrated form its basic structural and dynamic features.

- **In other words:**

DLM is the 3D-4D representation of the landscape map of a present landscape as a new type of geodata base.

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Types of geographic data layers in an integrated geodata base

1. NATURAL BACKGROUND (with homogenous natural landscape units as reference areas)

2. Productsof HUMAN IMPACTS (with parcels and/or subparcels as reference areas)

HARASKA
integrated layer "natural background"

integrated layer "human impacts"
HARASKA
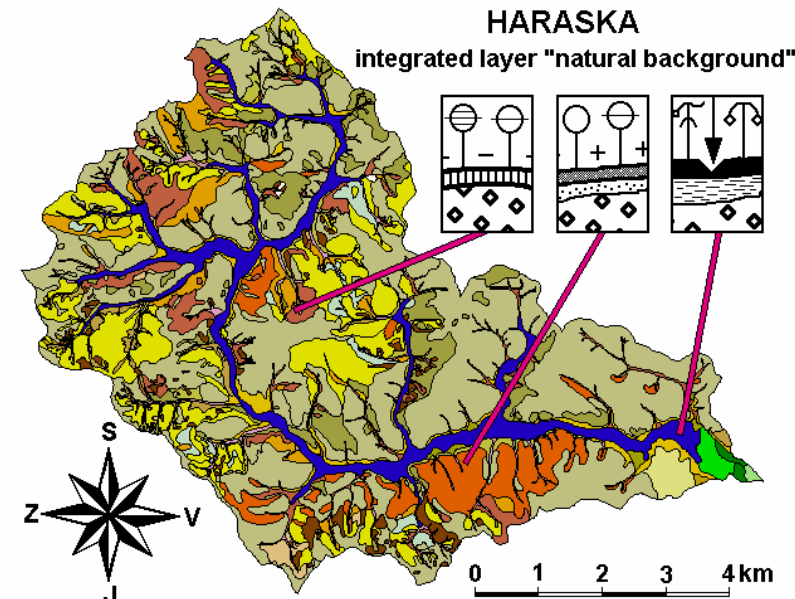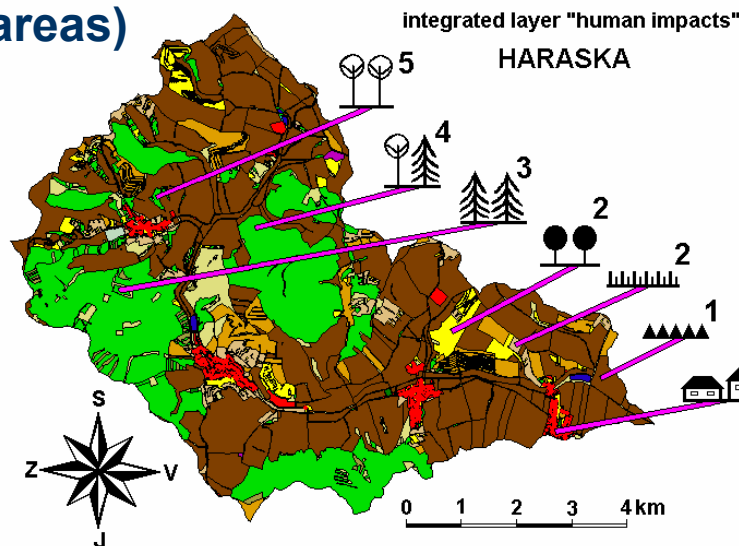
3. Human and social interests (development SOCIAL LIMITS in parcels and/or subparcels as reference units)

4. DIGITAL ELEVATION MODEL (carrying skeleton)

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DLM 3D presentation

HARASKA DEM terrain
Digital Elevation Model
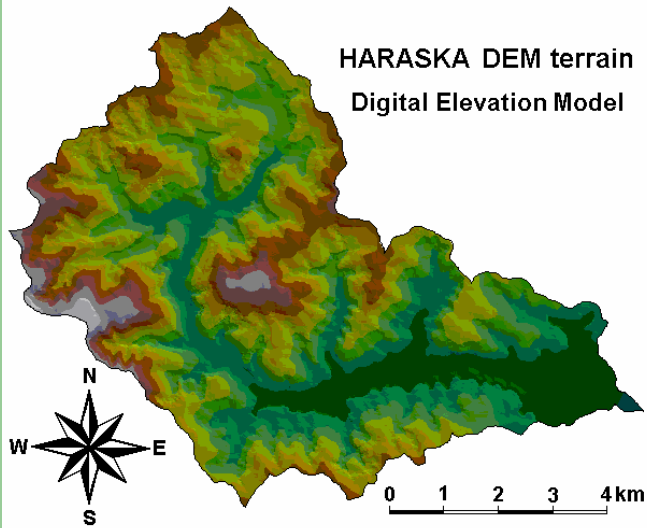
HARASKA overlaid logically ballanced layers in 3D view

Layer: soil types

Layer: integrated layer "natural background"

Layer: geology

N W E S

0   1   2   3   4 km
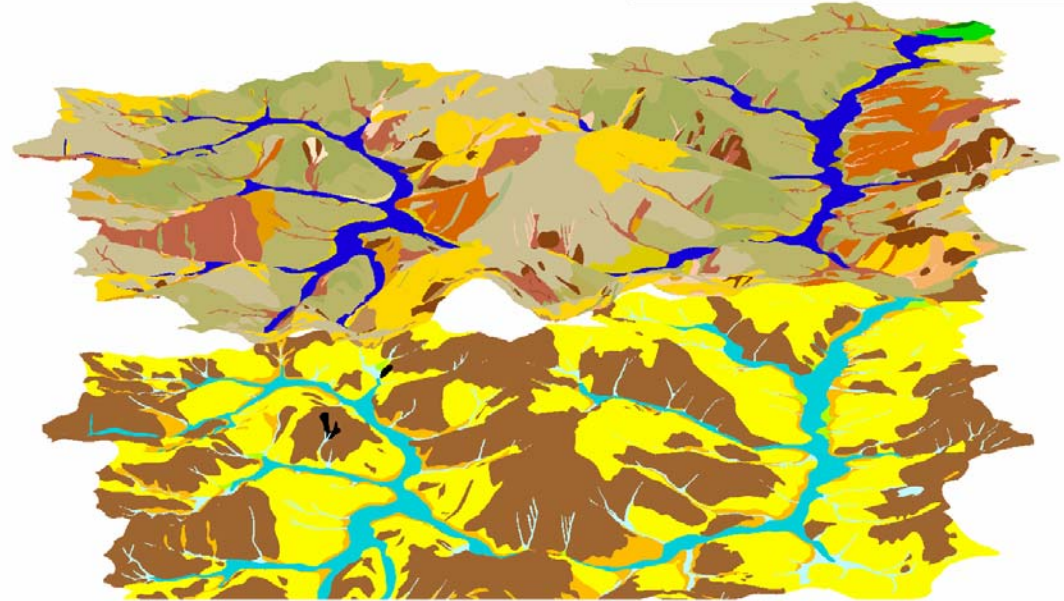
Combining integrated layer of natural background and derived analytic layers in 3D view

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DLM disintegration

Decomposition of an integrated data layer „natural background" into set of mutually referenced analytic layers.

HARASKA

INTEGRATED LAYER "NATURAL BACKGROUND"

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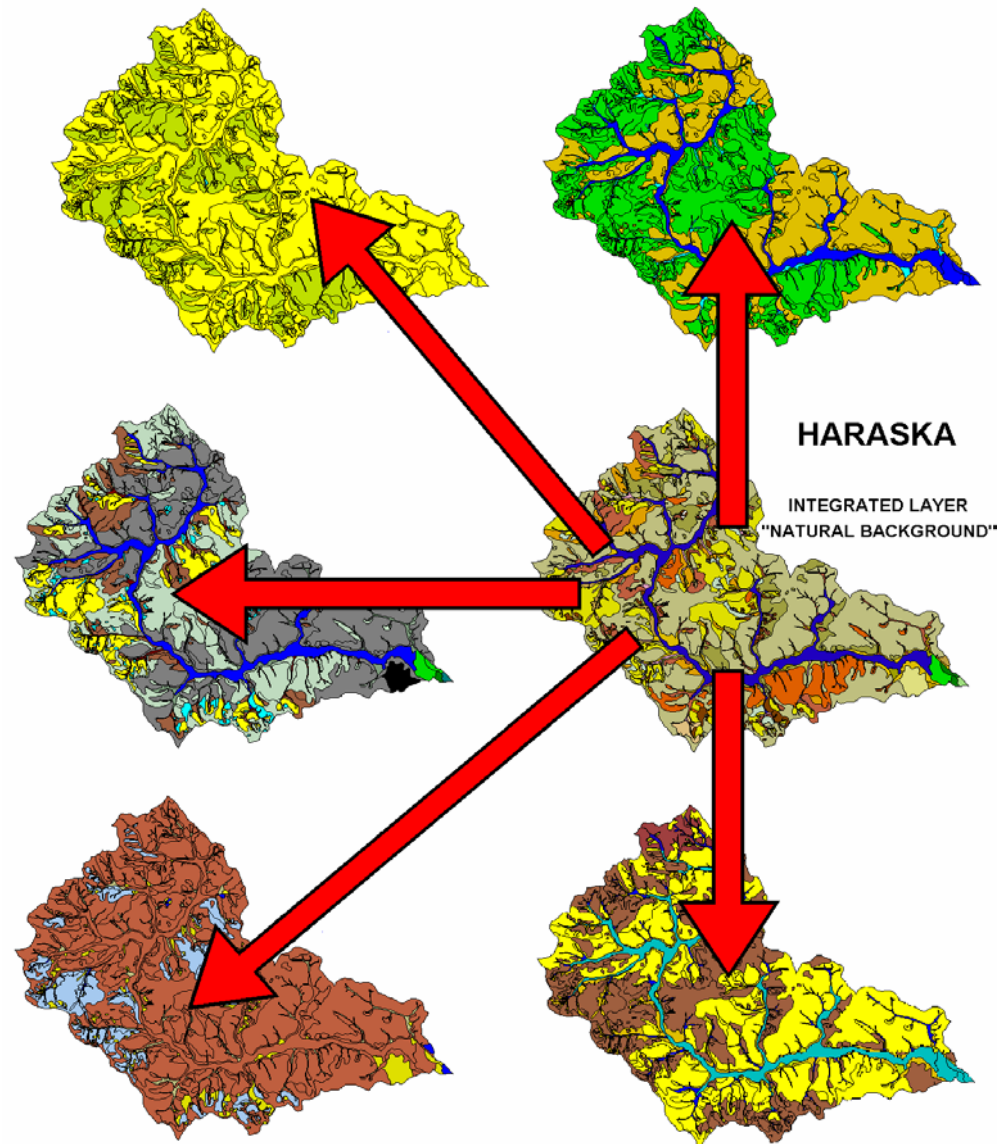
Differences between original and integrated geodata layers – one layer selected as the reference layer

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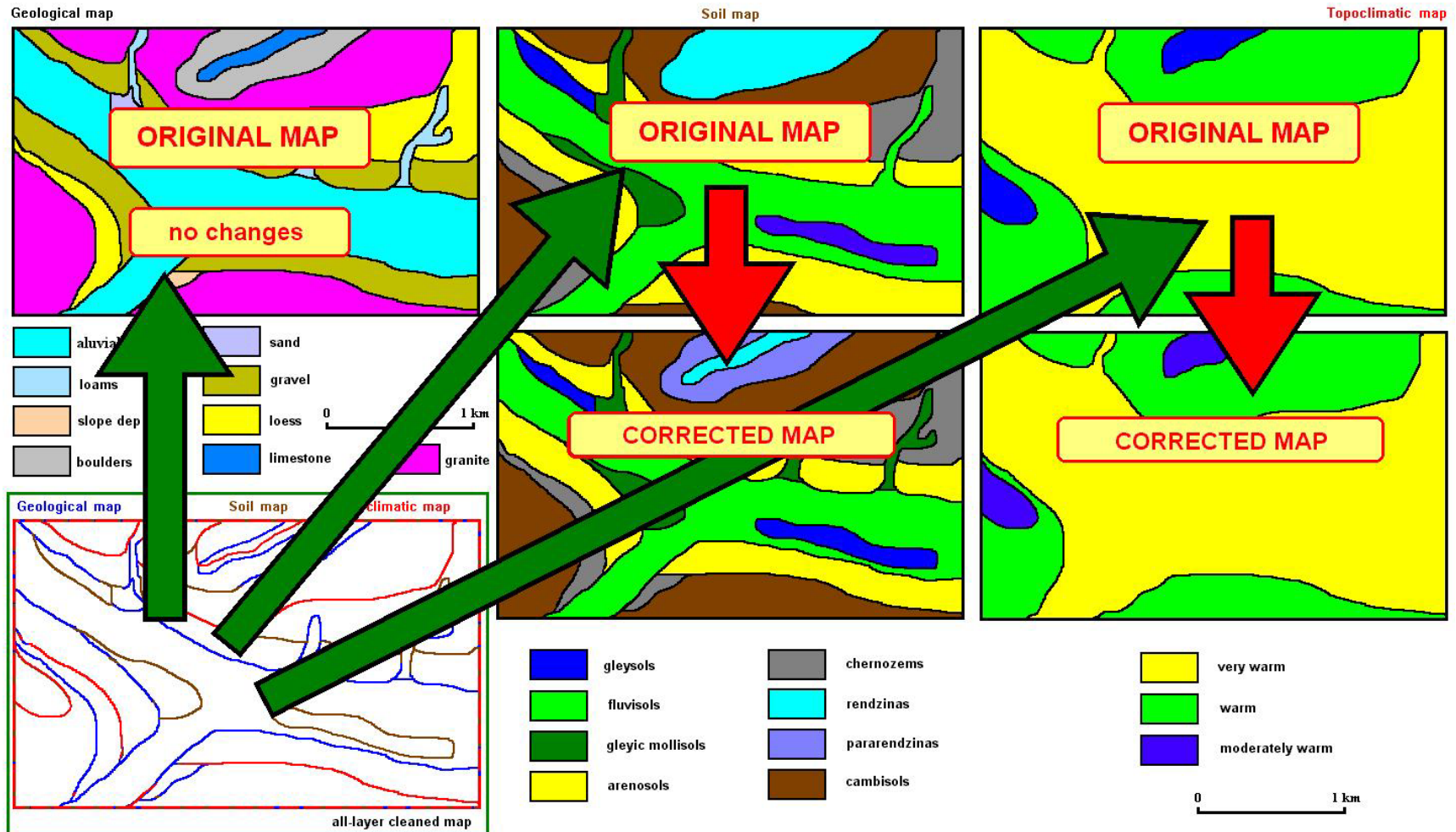
Construction of digital landscape model as integrated geodata base

DLM construction methods:

- **manual integration of analytic data layers in analogue form and consequent digitising,**
- **semiautomatic on-screen integration of digital analytic data layers,**
- **automatic integration of digital analytic data layers using clustering and classification techniques.**

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Construction of digital landscape model as integrated geodata base

DLM construction rules

General rules:

1. **geodata collection**
2. **data digitising, georeferencing, format unification**
3. **integration method selection**
4. **selection of reference layer**
5. **definition of consequence of layers to be integrated**

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Geodata analysis from landscape ecological viewpoint

1. select the reference layer as the most reliable geodata set
2. assess geodata reliability comparing with terrain
3. identify typical combinations of natural landscape features
4. identify regularities in natural features geospatial distribution

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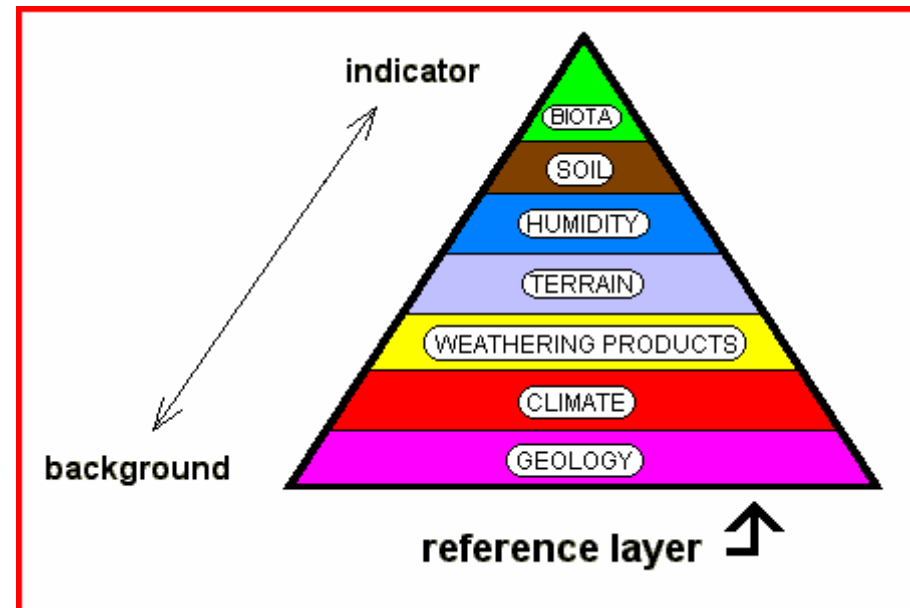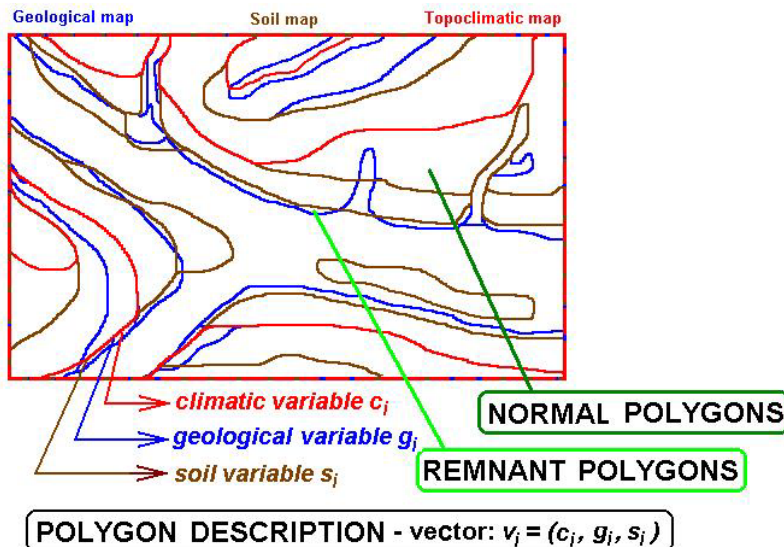
Automated DLM construction

It is based on expert knowledge consisting of formalized steps of manual and/or semi-automatic integration procedure.

Human participation cannot be completely excluded because of unlimited variality of geographical landscapes.

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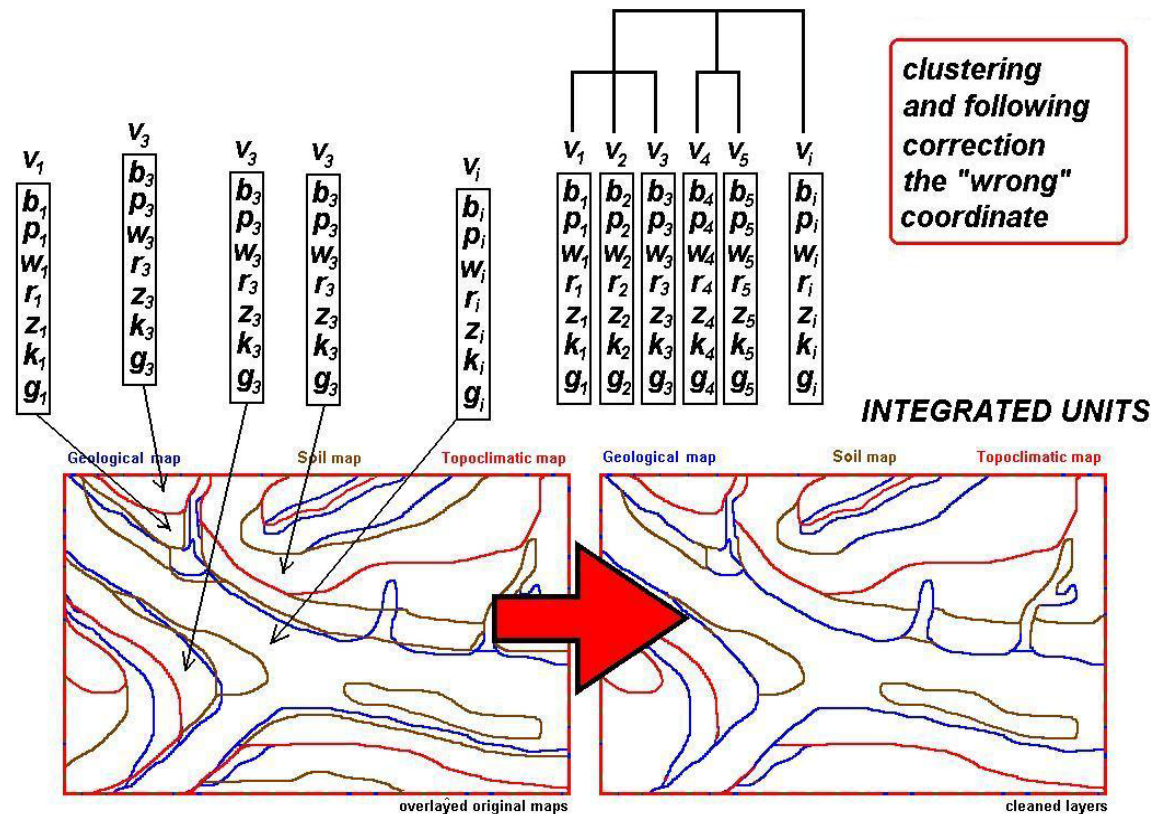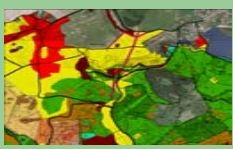
Example of standard integrated geodata layer „Natural background"

Integrated geodata layer presents natural features logically integrated both from mono- and polysystem views – as it is in reality.

Staré Město, Radišov a Petrušov

NATURAL BACKGROUND

Natural landscape unit classes:

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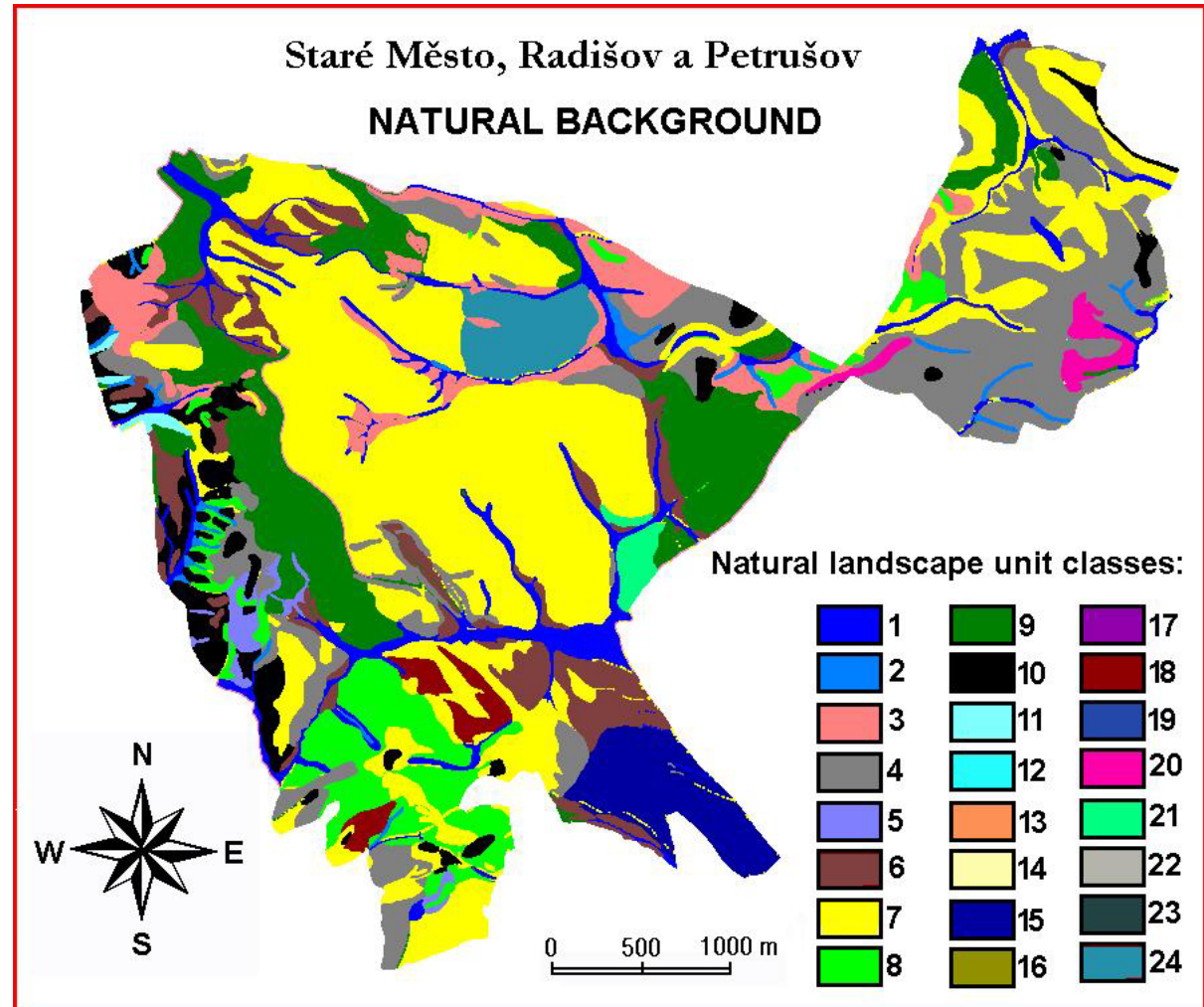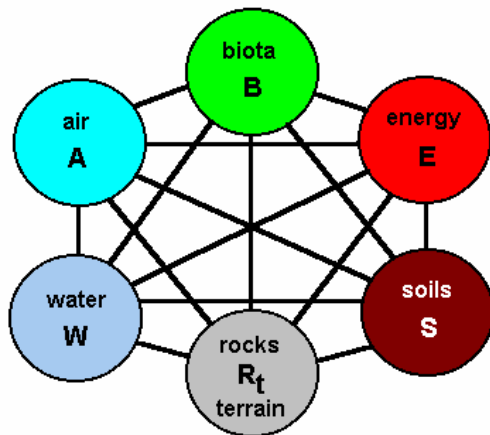
Polygon description in geodata base

Atribute table:

Polygon type – code description

Features included in the code.

Individual feature description in consequent attribute table columnes.

Separate columnes for climate, soils, geology, slope, humidity, etc. for analytic utilising (e.g. assessment, etc.).

Staré Město, Radišov a Petrušov
INTEGRATED NATURAL UNITS

Nature units described by 5-value-vectors: eg.
$X_i=(C,S,H,G,T)$

climate C=3
soil S=HMT
humidity H=2
geology G=R
slope T=1

8=(3HTM2R1)

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Example of application of integrated geodata for land use optimizing

variable	geology						elev			slop				clim			moist					soil													slope aspect								
	F	B	E	D	S	R	1	2	3	0	1	2	3	1	2	3	1	2	3	4	5	CISt	CIVm	CISt	CIkp	HBVm	HBfp	IPm	CSk	CSm	CSk	PRm	LIt	FOk	1	2	3	4	5	6	7	8	0
utilising																																											
alpine	2	0	0	0	0	0	0	0	2	0	0	0	3	0	1	3	1	3	2	0	0	0	1	2	1	3	1	3	0	0	0	0	0	0	3	3	2	1	0	0	2	3	0
water	0	0	1	2	0	3	3	2	1	3	1	0	0	3	2	1	0	1	1	2	3	0	0	0	1	0	0	1	1	1	3	1	0	3	1	1	2	3	3	3	2	1	3
scating	0	0	2	2	0	3	1	3	2	3	0	0	0	1	2	3	0	0	1	2	3	0	0	0	0	0	0	0	1	2	3	2	0	3	3	3	2	1	0	1	3	3	3
camping	2	2	1	0	2	3	2	3	1	3	2	1	0	3	2	1	3	3	1	0	0	2	3	3	1	3	1	2	2	1	1	0	0	1	1	1	2	2	3	3	1	1	3
sport	0	0	1	0	1	3	3	3	1	3	2	1	0	3	2	1	3	3	1	0	0	3	3	3	2	3	2	3	2	1	1	0	0	2	1	2	2	3	3	3	2	1	3
golf	3	2	2	1	1	0	2	3	2	2	3	1	0	3	2	1	3	2	1	1	0	2	3	2	3	3	3	2	1	1	1	0	0	1	1	1	3	2	1	2	1	1	1
arable	2	3	2	3	3	2	3	2	1	3	2	1	0	3	1	0	2	3	2	1	1	3	3	3	2	3	3	2	1	3	3	1	0	1	1	1	2	3	3	3	2	1	3
vineyard	3	2	1	0	1	0	2	3	1	1	3	2	0	3	2	0	3	3	1	0	0	3	2	2	0	1	0	0	1	1	0	3	1	0	0	0	1	2	3	3	0	0	0
orchard	3	3	2	1	2	0	2	3	1	0	3	2	1	3	3	1	2	3	2	1	0	3	3	2	3	2	2	2	0	0	2	0	0	2	0	1	2	3	3	2	2	1	3
pasture	3	1	3	3	2	3	1	2	3	1	2	3	0	1	2	3	1	2	3	3	3	2	1	2	3	2	3	3	2	2	2	0	0	3	1	1	2	2	0	0	3	3	2
forest	3	1	2	1	3	0	1	2	3	0	1	2	3	1	3	3	2	3	3	2	0	1	1	1	2	2	2	3	2	1	2	1	0	2	3	3	2	2	1	1	3	3	1
resident	3	2	0	0	2	0	2	3	1	3	2	1	0	3	2	1	3	2	1	0	0	3	3	1	1	3	1	1	1	1	0	0	0	0	0	1	2	2	3	3	1	0	3
variable	I	K	K	D	S	E	G	Z	M	0	1	2	3	1	2	3	1	2	3	4	5	CISt	CIVm	CISt	CIkp	HBVm	HBfp	IPm	CSk	CSm	CSk	PRm	LIt	FOk	1	2	3	4	5	6	7	8	0

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Search for optimum land use

Staré Město, Radišov a Petrušov
NATURAL BACKGROUND

Natural landscape unit classes:

1	9	17
2	10	18
3	11	19
4	12	20
5	13	21
6	14	22
7	15	23
8	16	24

0   500   1000 m
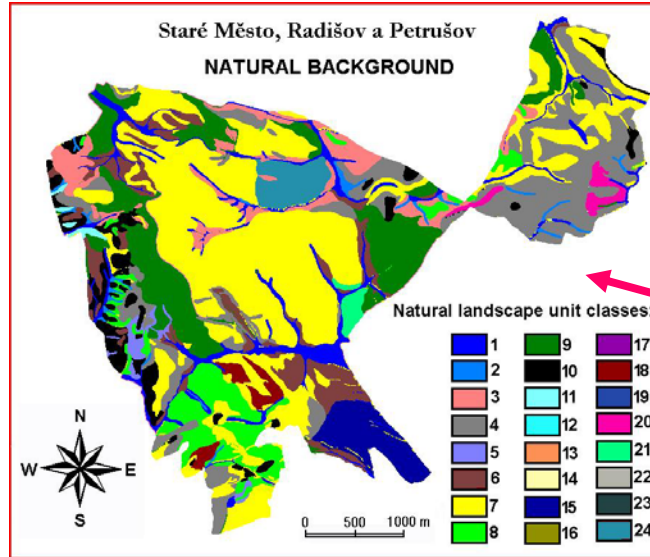
Basic data layers integrated in digital landscape model:

Natural background

Human impacts - Present land use

Staré Město, Petrušov, Radišov
Land Use in 1999

Land Use Forms:
waters
wetlands
forests
shrubs
pastures
orchards
small parcels
sportgrounds
arable land
gardens
waste deponies
abandoned
roads
railways
rendential
services
production
cemeteries

0   500   1000 m
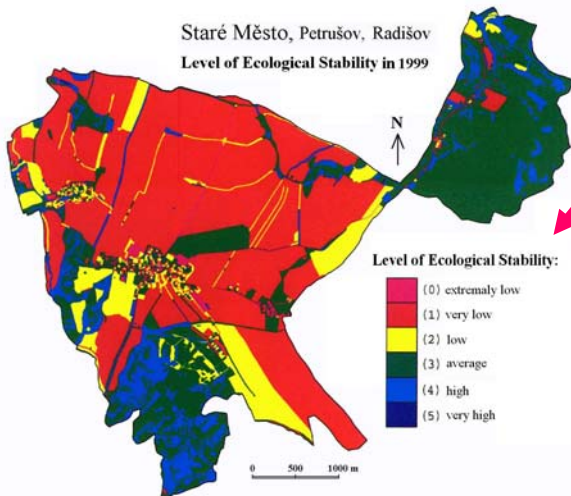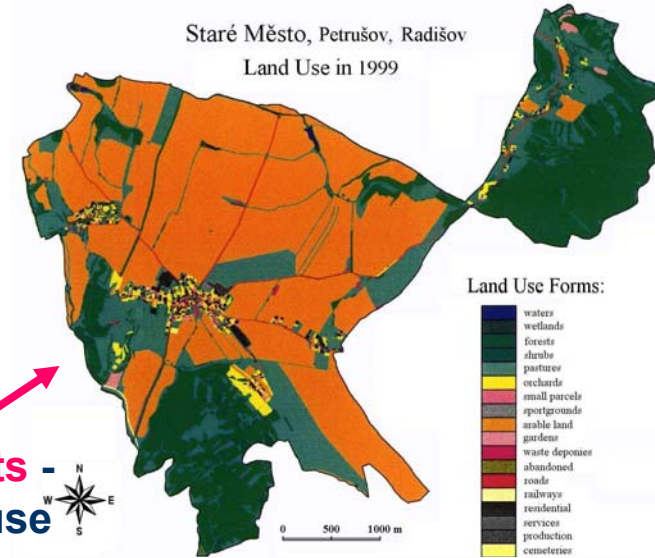
Level of ecological stability of area - as the difference between present and natural land use.

Staré Město, Petrušov, Radišov
Level of Ecological Stability in 1999

Level of Ecological Stability:
(0) extremaly low
(1) very low
(2) low
(3) average
(4) high
(5) very high

0   500   1000 m

Local social develop- ment limits and interests.

Staré Město, Petrušov, Radišov
Development Limits

Development limits:
regional biocentre
supraregional biocorridor
local biocorridor
important landscape element
nature reserve
local biocentre
lookout sectors
no limits

0   500   1000 m

The best landscape utilizing proposal respecting the natural potential and irreversible land use

Staré Město, Petrušov, Radišov
Final Landuse Proposal

Areas without Land Use Changes:
- waters
- wetlands
- forests
- shrubs
- pastures
- orchards
- small parcels
- sport grounds
- arable land
- gardens
- waste deponies
- abandoned
- roads
- railways
- residential
- services
- production
- cemeteries

Proposed land use changes as optimum utilizing for:
- alpine skying
- water recreation
- skating
- camping
- sport grounds
- golf grounds
- arable land
- orchards
- pastures
- forests
- residential

0   500   1000 m

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